Pipe thickness Calculation under internal Pressure

Introduction to ASME B31.3

This is standard for process piping. Two equations are used to design piping

Equation 3a for OD given

T = $\frac{PD}{2(SEW+PY)}$

Equation 3b for ID given

T = $\frac{P(d+2c)}{2[SEW-P(1-Y)]}$

Where:

T= required thickness (mm)

P = internal design pressure (MPa)

S = allowable stress from table A-1 / A -1M

D = outside diameter (mm)

d = Inside diameter (mm)

E = equality factor, from table A -1A (casting) or A1 -B (others)

W= Weld joint strength reduction factor, table 302.3.5

c = Mechanical Allowance (including corrosion allowance, thread allowance, erosion allowance).

Y = coefficient from table 304.1.1 (t<D/6) or this equation (t >= D/6)

$$Y = \frac{d+2c}{D+d+2c}$$

Minimum Required Data

- Internal design pressure
- Internal design temperature
- Outside or inside diameter
- Pipe material

Case Study Problem

Determine nominal thickness of pipe with following design condition

Internal design pressure 1.5 MPa

Internal design temperature 200 deg C

Nominal pipe size 4”

Material SA 106 Gr.B

T = $\frac{PD}{2(SEW+PY)}$

P= 1.5 MPa

D = 114.3 mm

S = 138 MPa at 200 deg C (table A -1 M)

E= 1 (table A-1B)

W = 1 (table 302.3.5)

Y = 0.4 (table 304.1.1)

C= 3mm (assumed corrosion allowance)

T = $\frac{1.5*114.3}{2*[(138*1*1)+(1.5*0.4)]}$ + 3 = 3.62 mm

Define Nominal Thickness

tn: 6.02mm (sch 40 from asme B36.10)

tf (finish thickness): 5.27 mm (pipe tolerance 12.5%)

Compare requires thickness and finished thickness

Design is acceptable if tf >= t

Tf (5.27 mm) > t (3.62 mm)